AMENDMENTS TO THE SPECIFICATION:

On page 1, line 1 please insert a title and heading as follows:

CALIBRATABLE MICROWAVE CIRCUIT WITH ILLUMINABLE GAAS-FET, CALIBRATING DEVICE AND PROCESS

BACKGROUND OF THE INVENTION

The heading beginning on page 1, line 1 has been changed as follows:

~~Description~~ Field of the Invention

The paragraphs beginning on page 1, line 3 have been changed as follows:

The invention relates to a microwave circuit having electronic switching components with field-effect transistors (FETs) on a substrate base made of gallium arsenide. The microwave circuit may, in particular but not exclusively, be designed as a stepped damping circuit for rapid switching of high frequency signals. The switching components or GaAs-FETs can be illuminated by a light source, whereby the light thereby falling on the field-effect transistors, in particular, substantially shortens the switching times of the field-effect transistors or of the electronic switching components.

Field-effect transistors can be very easily made on a semiconductor chip, as is known. Furthermore, they require only very little control power. Illumination of field-effect transistors on a gallium arsenide base, and particularly of metal-semiconductor field effect transistors (MESFETs), has the result that impurities which occur on the semiconductor boundary surfaces, particularly under the gate electrode and which exert a negative influence on the switching times of the field-effect transistors, are recharged more rapidly. The negative influence of the impurities is known with MESFET components as the gate-lag effect and is measurable as extremely slow alteration of the path resistance. The cause of this is the slow charging and discharging of the surface impurities in the source-gate path and the

gate-drain path. Illuminating field-effect transistors generates electron-hole pairs which neutralise the charges trapped at the impurity sites. The illumination suppresses the gate-lag effect and shortens the switching time by a factor of 10 to 100.

For example, DE 102 28 810 A1 discloses a microwave circuit of this type. The digitally controllable damping member described there is constructed with field-effect transistors as switching elements that are illuminable by a light source, for example, an LED. The light sources are operated unregulated and controlled so as to be independent of other variables influencing the switching time of the field-effect transistors, so that, in particular, the light intensity and ~~colour~~ or the radiation energy cannot be changed during operation of the damping member.

On page 3, line 1 please insert a heading as follows:

GENERAL DESCRIPTION OF THE INVENTION

The paragraph beginning on page 3, line 1 has been changed as follows:

~~It is an object of the present~~ <u>The</u> invention ~~to provide~~ <u>provides</u> a microwave circuit with shorter, more consistent and reproducible switching times and a corresponding calibrating device and a corresponding calibrating method.

Please delete the paragraph beginning on page 3, line 5.

On page 3, after 9 please insert new paragraphs as follows:

Accordingly, the invention provides an electronic microwave circuit including GaAs field-effect transistors integrated onto a semiconductor substrate, for switching electronic high frequency input signals and at least one light source for illuminating the GaAs field-

effect transistors, wherein at least one of the intensity of the light source and the color of the light source may be changed during operation.

The invention also provides a calibrating device for calibrating the intensity and/or color of a light source of an electronic microwave circuit, the intensity and/or color of the light source being changeable during operation, the microwave circuit including GaAs field-effect transistors illuminable by the light source, with a signal generator for generating high frequency input signals to a calibrating output, via which the high frequency input signals are fed to an input of the microwave circuit, with a calibrating input via which the high frequency signals altered by the microwave circuit are fed again to the calibrating device, with a control unit, for controlling the light source and the switching processes of the microwave circuit via a calibrating connection, and of the signal generator, whereby the control unit evaluates high frequency output signals input via the calibrating input and places the result of the evaluation in a store of the microwave circuit.

The invention further provides a method for operating a calibrating device of a microwave circuit of the invention including the following steps:

(a) stepwise adjusting and detecting influencing variables including intensity and/or color of the light source of the microwave circuit and at least one of the measurement variables selected from the group consisting of:

(b) the polarity of the signal voltage of the high frequency signal to be switched, relative to the control voltage with which the field-effect transistors are controlled,

· the size of the signal voltage of the high frequency signal to be switched, relative to the control voltage with which the field-effect transistors are controlled,

· the temperature of the field-effect transistors,

· the level of the signal voltage of the high frequency signal to be switched, and

- the level of the signal frequency of the high frequency signal to be switched;

(b) storing the value combinations or of the value tuples of the changed and detected values of the influencing variables and of the measurement variables

(c) evaluating the value combinations or value tuples; and

(d) transferring of the evaluation results to the microwave circuit.

The paragraph beginning on page 3, line 10 has been changed as follows:

The ~~present~~ invention has the advantage that, with illuminable field-effect transistors, the microwave circuit can keep the switching times of the field-effect transistors particularly short and constant with little effort, so that the switching times are predictable dependent upon operating parameters. Furthermore, the power requirement of the light sources and the heating effect of the light source on the field-effect transistors is ~~minimised~~ minimized.

Please delete the paragraph on page 3, line 19.

The paragraphs beginning on page 3, line 21 have been changed as follows:

According to a further ~~development~~ embodiment of the invention, the microwave circuit is designed such that the light source is able to illuminate in different ~~colours~~ color alternately or simultaneously and that thereby ~~colour~~ color combinations can be created whereby the light source is able to illuminate, for example, in red, yellow, green, white, blue, ultraviolet and infrared.

According to another further ~~development~~ embodiment of the invention, the microwave circuit has a control device which controls or regulates the intensity and/or ~~colour~~ color of the light source.

It is also advantageous if the control device controls or regulates the intensity and/or the ~~colour~~ color of the light dependent upon at least one measurement variable or a combination of measurement variables.

The paragraphs beginning on page 4, line 13 has been changed as follows:

In another further ~~development~~ embodiment, the control device controls or regulates the light source in such a manner that the switching times of the field-effect transistors remain constant over the whole range of values occurring in operation, whereby the switching times are ~~minimised~~ minimized.

Advantageously, the control device has a store in which the optimum intensity and/or ~~colour~~ color of the light source is stored for a plurality of values of the measurement variables, whereby the control device sets or controls the intensity and/or the ~~colour~~ color of the respective light source, based on the values stored in the store of the measurement variables used.

The paragraph beginning on page 4, line 30 has been changed as follows:

The calibrating device according to the invention is capable of calibrating the ~~colour~~ color and/or intensity of the light source of the microwave circuit across settable value ranges of the measurement variables in order to make the light intensity and/or the light ~~colour~~ color optimally settable.

On page 5, after line 7 please insert a heading as follows:

BRIEF DESCRIPTION OF THE DRAWINGS

On page 5, after line 17 please insert a heading as follows:

DETAILED DESCRIPTION

The paragraphs beginning on page 6, line 18 have been changed as follows:

The switching times of the field-effect transistors 15 illuminable by the light source 2 are dependent on a series of influencing variables. In particular, the switching times are dependent on the light intensity or the illumination intensity with which the light source 2 illuminates the field-effect transistors 15, on the ~~colour~~ color of the light emitted by the light source 2, on the temperature of the field-effect transistors 15, on the size of the signal voltage to be switched by the respective field-effect transistor 15 relative to the control voltage with which the field-effect transistor 15 is controlled, whereby the signal voltage is dependent on the high frequency input signal 16, on the level of the signal frequency, which corresponds in the exemplary embodiment to the frequency of the high frequency input signal 16 and on the polarity of the signal voltage relative to the control voltage.

In most cases, it is desirable for the switching times of the field-effect transistors 15 and therefore of the microwave circuit 1 to remain constant over a wide range of influencing variable values. However, since the level of the high frequency input signals varies naturally, although the control voltage for the field-effect transistors 15 can be freely selected only within a very narrow range and the temperature of the field-effect transistors can be adapted or controlled or regulated only with a very great technical effort and only very slowly, in the exemplary embodiment according to the invention, the intensity and/or ~~colour~~ color of the light from the light source 2 is set or controlled or regulated dependent upon an influencing

variable or a combination of the remaining influencing variables (designated below as measurement variables).

The light source 2 whose ~~colour~~ color and/or intensity can be altered during operation is controlled in the exemplary embodiment via the digital-to-analogue converter 13 of the control device 6 by means of a digital signal. The digital signal controls the intensity and/or the ~~colour~~ color of the light source 2. The light source 2 may be designed, for example, as a two-~~colour~~ color LED, which is able to radiate in one of two ~~colours~~ colors or in both simultaneously. A light source 2 and/or a laser diode emitting strongly in the ultraviolet or the infrared region can also be used.

The paragraphs beginning on page 8, line 17 have been changed as follows:

In the exemplary embodiment shown, the control device 6 sets the light intensity and/or ~~colour~~ color from the light source 2 via a D/A converter 13, dependent upon one or more of the influencing variables, for example

In the exemplary embodiment shown, the intensity and/or ~~colour~~ color of the light from the source 2 is regulated by the control device 6. For this purpose, a sensor 8 is provided closely adjoining the field-effect transistor 15 concerned. The sensor 8 measures the illumination intensity of the light source 2 concerned and passes it on to the control device 6. In the exemplary embodiment, the sensor 8 also measures the temperature in the region of the field effect transistor 15 concerned. In other exemplary embodiments, the sensor 8 may, for example, be integrated on the semiconductor chip 5. In further exemplary embodiments, the sensor 8 may, for example, measure only the temperature, whereby only the intensity of the light source 2 concerned can be controlled by the control device 6.

The control device 6 which, in the exemplary embodiment shown regulates the intensity and/or ~~colour~~ color of the light from the relevant light source 2 dependent upon the measurement variables, for example

The paragraph beginning on page 9, line 12 has been changed as follows:

such that the switching times of the relevant field-effect transistor 15 is constant over the expected or permitted value range, selects the light intensity to be just as large as necessary and/or such that the wavelength of the light ~~colour~~ color is optimal. The heat generated and the influence of the light source 2 on the temperature of the field-effect transistor 15 is reduced thereby. Furthermore, in the exemplary embodiment shown, the light intensity and/or ~~colour~~ color is selected by the control device 6 such that the switching times of the field-effect transistor 15 concerned are as short as possible.

In the store 7 of the control device 6, for each combination of the occurring values of the measurement variables used, wherein only one measurement variable can be used, the optimal light intensity and/or ~~colour~~ color is stored. In the exemplary embodiment shown, the intensity and/or ~~colour~~ color of the light is optimally selected such that the shortest possible switching time is achieved, whereby the intensity and/or ~~colour~~ color of the light can be adjusted such that, even where the measurement variable values are unfavourable, a constant switching time can be set by regulating the ~~colour~~ color and/or intensity of the light, which is constant over all the expected or permissible values of the measurement variables.

In the exemplary embodiment shown, the microwave circuit 1 and the intensity and/or ~~colour~~ color of the light source 2 is calibrated before use, for example, in a measurement arrangement, by means of a calibrating device 20 according to the invention. The calibrating device 20 connected to the microwave circuit 1 is operated using the method according to the invention.

The calibrating device 20 essentially has a signal generator 21 and a controller (control unit) 22 with a store 25. The signal generator 21 generates the high frequency input signal 16 and passes it via a calibrating output 29 to the input 9 of the microwave circuit 1. By means of a calibrating connection 24 which is linked to the control connection 11, the controller 22 controls the microwave circuit 1 or the control device 6, whereby it switches over between the required damping values by means of digital control signals and sets the desired intensity and/or ~~colour~~ color of light. The high frequency output signal 17 is fed to the controller 22 via a calibrating input 30 linked to the output 10. Furthermore, the controller 22 controls the signal generator 21, whereby the signal generator 21 generates the high frequency output signals 16 required by the controller 22 and, optionally via a control connection 23, controls a cooling/heating system 31 for altering the temperature of the microwave circuit 1 or of the field-effect transistors 15.

The paragraphs beginning on page 11, line 11 have been changed as follows:

The temperature of the field-effect transistors 15 may optionally be varied and set by the controller 22 via the heating/cooling system 31. The intensity or ~~colour~~ color of the light from the light source 2 is varied and set by the controller 22 via the control connection 11 and the control device 6. By means of the temperature determined by the sensor 8 via the control device 6 and the control connection 11, the controller 22 is able to regulate the temperature of the field-effect transistors 15 and to keep it constant or alter it by controlling the heating/cooling system.

The values of the influencing variables are varied or altered step-by-step and the switching time of the relevant field-effect transistor 15 is determined for each change in that the time point of the switching command from the controller 22 is compared with the start of the damping in the high frequency output signal 17 as received by the controller 22, whereby

the step widths are selectable and the value ranges of the influencing variables lie within predictable or permissible limits or are so selected. For example, one influencing variable is changed step-by-step in each case and simultaneously, the other influencing variables are kept constant. The values of the influencing variables thereby occurring are stored in the store 25 and then evaluated in that for each combination of values of the measurement variables, set values are determined for each optimal intensity and/or ~~colour~~ color of the light source 2 for which a minimal switching time can be kept constant across all possible value combinations. The evaluation is either stored first in the form of an n-dimensional table in the store 25 and then transmitted to the store 7 or is directly written into the store 7.